What is claimed is: US

1. A semiconductor device, comprising:

an insulating substrate having a surface on which an SiO_2 film is formed; and

a single-crystal silicon substrate bonded with the insulating substrate,

wherein, the single-crystal silicon substrate includes a BOX layer, a hydrogen ion implantation section in which distribution of hydrogen ions peaks in the BOX layer, and a single-crystal silicon thin film formed on the BOX layer, and has a surface which is on a single-crystal silicon thin film side with respect to the BOX layer and on which an SiO_2 film formed,

the surface of the insulating substrate, where the SiO_2 film is formed, is bonded with the surface of the single-crystal silicon substrate, where the SiO_2 film is formed, and

a part of the single-crystal silicon substrate is separated at the hydrogen ion implantation section, and the BOX layer is removed from a remaining part of the single-crystal silicon substrate, the remaining part still being on the insulating substrate after the part is separated.

2. The semiconductor device as defined in claim 1, wherein, in different regions on the insulating substrate, the single-crystal silicon thin film and a non-single-crystal silicon thin film are formed.

3. The semiconductor device as defined in claim 1, wherein, the single-crystal silicon thin film is about not more than 70nm thick.

4. The semiconductor device as defined in claim 1, wherein, the single-crystal silicon thin film is about not more than 20nm thick.

5. The semiconductor device as defined in claim 2, wherein, the non-single-crystal silicon thin film is composed of polycrystalline silicon.

6. The semiconductor device as defined in claim 2, wherein, the non-single-crystal silicon thin film is composed of continuous grain silicon.

7. The semiconductor device as defined in claim 2, wherein, the non-single-crystal silicon thin film is composed of amorphous silicon.

8. The semiconductor device as defined in claim 7, wherein, a non-single crystal silicon thin-film transistor, which includes a gate insulating film made up of at least one insulating film including silicon nitride, is formed using the amorphous silicon thin film.

9. The semiconductor device as defined in claim 1, wherein, the transistor formed using the single-crystal silicon thin film is arranged such that, from an insulating substrate side, a gate electrode, a gate insulating film, and the single-crystal silicon thin film are formed in this order.

10. The semiconductor device as defined in claim 9, wherein, at least a part of the transistor formed using the single-crystal silicon thin film includes an interlayer insulating film and metal interconnects provided further on the single-crystal silicon thin film.

11. The semiconductor device as defined in claim 1, wherein, the transistor formed using the single-crystal silicon thin film is arranged such that, from an insulating substrate side, an interlayer insulating film, a metal interconnects layer, an interlayer insulating film, a gate electrode, a gate insulating film, and the single-crystal

silicon thin film are formed in this order, and in at least a part of the transistor, an interlayer insulating film and metal interconnects are further provided on the single-crystal silicon thin film.

12. The semiconductor device as defined in claim 1, wherein, the insulating substrate is a high strain point glass composed of an alkaline-earth alumino-borosilicate glass.

13. The semiconductor device as defined in claim 1, wherein, the insulating substrate is composed of any one of a barium borosilicate glass, a barium alumino-borosilicate glass, an alkaline-earth alumino-borosilicate glass, a borosilicate glass, an alkaline-earth-zinc-lead-alumino-borosilicate glass, and an alkaline-earth-lead-alumino-borosilicate glass.

14. The semiconductor device as defined in claim 1, wherein, a difference of linear expansion between the insulating substrate and the single-crystal silicon substrate is about not more than 250ppm at temperatures in a range between substantially room temperatures and 600°C.

15. The semiconductor device as defined in claim 1, wherein, the insulating substrate is composed of a high strain point glass whose strain point is not less than 500°C.

16. The semiconductor device as defined in claim 1, wherein, on a substantially entire surface of the insulating substrate, the single-crystal silicon thin film is formed.

17. A semiconductor device, comprising:

an insulating substrate having a surface on which an SiO_2 film is formed; and

a single-crystal silicon substrate bonded with the insulating substrate,

wherein, the single-crystal silicon substrate includes a porous silicon layer and a single-crystal silicon thin film formed on the porous silicon layer and has a surface which is on a single-crystal silicon thin film side with respect to the porous silicon layer and on which an SiO_2 film is formed,

the surface of the insulating substrate, where the SiO_2 film is formed, is bonded with the surface of the single-crystal silicon substrate, where the SiO_2 film is formed, and

a part of the single-crystal silicon substrate is separated at the porous silicon layer, and the porous silicon layer is removed from a remaining part of the single-crystal silicon substrate, the remaining part still being on the insulating substrate after the part is separated.

18. The semiconductor device as defined in claim 17, wherein, in different regions on the insulating substrate, the single-crystal silicon thin film and a non-single-crystal silicon thin film are formed.

19. The semiconductor device as defined in claim 17, wherein, the single-crystal silicon thin film is about not more than 70nm thick.

20. The semiconductor device as defined in claim 17, wherein, the single-crystal silicon thin film is about not more than 20nm thick.

21. The semiconductor device as defined in claim 18, wherein, the non-single-crystal silicon thin film is composed of polycrystalline silicon.

22. The semiconductor device as defined in claim 18, wherein, the non-single-crystal silicon thin film is

composed of continuous grain silicon.

23. The semiconductor device as defined in claim 18, wherein, the non-single-crystal silicon thin film is composed of amorphous silicon.

24. The semiconductor device as defined in claim 23, wherein, a non-single crystal silicon thin-film transistor, which includes a gate insulating film made up of at least one insulating film including silicon nitride, is formed using the amorphous silicon thin film.

25. The semiconductor device as defined in claim 17, wherein, the transistor formed using the single-crystal silicon thin film is arranged such that, from an insulating substrate side, a gate electrode, a gate insulating film, and the single-crystal silicon thin film are formed in this order.

26. The semiconductor device as defined in claim 25, wherein, at least a part of the transistor formed using the single-crystal silicon thin film includes an interlayer insulating film and a metal interconnects layer provided further on the single-crystal silicon thin film.

27. The semiconductor device as defined in claim 17, wherein, the transistor formed using the single-crystal silicon thin film is arranged such that, from an insulating substrate side, an interlayer insulating film, a metal interconnects layer, an interlayer insulating film, a gate electrode, a gate insulating film, and the single-crystal silicon thin film are formed in this order, and in at least a part of the transistor, an interlayer insulating film and metal interconnects are further provided on the single-crystal silicon thin film.

28. The semiconductor device as defined in claim 17, wherein, the insulating substrate is a high strain point glass composed of an alkaline-earth alumino-borosilicate glass.

29. The semiconductor device as defined in claim 17, wherein, the insulating substrate is composed of any one of a barium borosilicate glass, a barium alumino-borosilicate glass, an alkaline-earth alumino-borosilicate glass, a borosilicate glass, an alkaline-earth-zinc-lead-alumino-borosilicate glass, and an alkaline-earth-lead-alumino-borosilicate glass.

30. The semiconductor device as defined in claim 17,

wherein, a difference of linear expansion between the insulating substrate and the single-crystal silicon substrate is about not more than 250ppm at temperatures in a range between substantially room temperatures and 600°C.

31. The semiconductor device as defined in claim 17, wherein, the insulating substrate is composed of a high strain point glass whose strain point is not less than 500°C.

32. The semiconductor device as defined in claim 17, wherein, on a substantially entire surface of the insulating substrate, the single-crystal silicon thin film is formed.

33. A method of manufacturing a semiconductor device in which a single-crystal silicon substrate is bonded with an insulating substrate having a surface on which an SiO_2 film is formed, comprising the steps of:

(I) bonding the surface of the insulating substrate, on which the SiO_2 film is formed, with a surface of the single-crystal silicon substrate including a BOX layer, a hydrogen ion implantation section in which distribution of hydrogen ions peaks in the BOX layer, and the

single-crystal silicon thin film formed on the BOX layer, the surface of the single-crystal silicon substrate being on a single-crystal silicon thin film side with respect to the BOX layer and having an SiO_2 film formed thereon;

(II) after the step (I), separating a part of the single-crystal silicon substrate at the hydrogen ion implantation section; and

(III) removing the BOX layer from a remaining part of the single-crystal silicon substrate, the remaining part still being on the insulating substrate after the step (II).

34. The method as defined in claim 33, wherein, the step (I) is carried out in a vacuum.

35. The method as defined in claim 33, wherein, after the step (I), heat treatment is carried out.

36. The method as defined in claim 33, wherein, before the step (I), the single-crystal silicon substrate and the insulating substrate are cleaned and activated.

37. The method as defined in claim 36, wherein, the single-crystal silicon substrate and the insulating substrate are cleaned and activated by carrying out RCA (SC-1) clean.

38. A method of manufacturing a semiconductor device in which a single-crystal silicon substrate is bonded with an insulating substrate having a surface on which an SiO_2 film is formed, comprising the steps of:

(i) bonding the surface of the insulating substrate, where the SiO_2 film is formed, with a surface of the single-crystal silicon substrate including a single-crystal silicon thin film formed on a porous silicon layer, the surface of the single-crystal silicon substrate being on a single-crystal silicon thin film side with respect to the porous silicon layer and having an SiO_2 film formed thereon;

(ii) after the step (i), separating a part of the single-crystal silicon substrate at the porous silicon layer; and

(iii) removing the porous silicon layer from a remaining part of the single-crystal silicon substrate, the remaining part still being on the insulating substrate after the step (ii).

39. The method as defined in claim 38, wherein, the step (i) is carried out in a vacuum.

40. The method as defined in claim 38, wherein,

after the step (i), heat treatment is carried out.

41. The method as defined in claim 38, wherein, before the step (i), the single-crystal silicon substrate and the insulating substrate are cleaned and activated.

42. The method as defined in claim 41, wherein, the single-crystal silicon substrate and the insulating substrate are cleaned and activated by carrying out RCA (SC-1) clean.